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ORIGINAL PAPER

Teaching Non-target Information to Children with Disabilities: An Examination of Instructive Feedback Literature

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Abstract Systematic trial-based learning procedures are commonly used to teach students with disabilities in special education settings. Instructive feedback is a procedure created to increase the efficiency of trial-based learning procedures. It involves the planned addition of non-target information that is systematically placed in the consequent events of learning trials. This systematic review examines the instructive feedback literature that was conducted since the only previous review was published in 1995. An extensive search of published and gray literature yielded a total of 54 eligible studies. Across studies, participants acquired an average of 64% of the non-target information presented through the instructive feedback procedure. In group studies of instructive feedback, participants exhibited an average gain of 55% of the extra information provided to peers. Results suggest that the instructive feedback procedure can be used to increase the efficiency of trial-based learning for students with disabilities of all ages. Instructive feedback is recommended as an effective strategy for enhancing trial-based teaching procedures for students with disabilities.

Keywords Instructive feedback · Special education · Discrete trial teaching · Systematic review

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Introduction

Educators are tasked with providing students with the knowledge and skills necessary to succeed in academic and recreational settings. However, students with disabilities face a range of challenges throughout this process, and few teachers have the appropriate training to teach special populations of learners, especially within the context of the general education classroom (Snell and Brown 2011). The field of special education aims to provide effective interventions for students with disabilities that adversely affect their academic and adaptive outcomes. Research suggests that students with disabilities and struggling learners benefit from systematic instruction (Zigmond and Kloo 2011). Systematic instruction involves the direct teaching of targeted incremental learning goals using planned prompting and error correction methods, a high number of student responses, and positive reinforcement for correct answers (Gersten et al. 1986).

Planned response prompting procedures are a set of systematic instruction methods that feature the use of explicit prompts that take the form of physical guidance, modeling, vocal instructions, or visual cues (Snell and Brown 2011). These prompts are provided either before or after an instruction is given to the student, in order to facilitate correct responding and minimize errors (Wolery et al. 1986). Over time, prompts are systematically faded so that children learn to respond to naturally occurring stimuli (Wolery and Gast 1984). This category of teaching strategies includes procedures such as the system of least prompts (Billingsley and Romer 1983; Snell 1983; Doyle et al. 1988), most to least prompting (Demchak 1990; Wolery and Gast 1984), progressive and constant time delay (Touchette 1971; Snell and Gast 1981), and simultaneous prompting (Gibson and Schuster 1992; Morse and Schuster 2004). A wealth of evidence supports the use of these procedures to teach varied learning targets to a wide variety of learning populations, including children with moderate to severe disabilities (Browder et al. 1981); preschool-aged children (Doyle et al. 1990b); school-aged children and adolescents (Gast et al. 1988; Schuster et al. 1988); and adults with disabilities (Palmer et al. 1999).

Though there is a broad evidence base supporting the effectiveness of response prompting procedures in helping students acquire novel skills, special educators require teaching procedures that are both effective *and efficient*. The efficiency of a procedure can be described either in terms of the amount of instructional time (or trials-to-criterion) that a child requires to acquire a learning target, or the number of learning targets that can be acquired within a given set of instructional sessions (Ault et al. 1989). "Instructive feedback" is a teaching strategy that can be embedded in response prompting procedures to increase the efficiency of learning. Instructive feedback (IF) refers to the planned addition of extra non-target information in the consequent events of systematic instruction trials in order to facilitate acquisition of this additional information (Werts et al. 1995). When instructive feedback is provided, the learner is neither required to respond, nor reinforced for responding (Werts et al. 1995). For example, a teacher might hold up a card featuring the letter 'A' and ask the child to identify the letter, saying,

"What letter?". The teacher might then prompt the response vocally, by saying "A". When the child responds correctly, by saying "A", the teacher might praise the child, and flip the card around to show a picture of the number 1, saying, "Nice job! That is A, and this is the number 1." The added stimulus and statement at the end is the instructive feedback on additional non-target information (the number 1). Non-target information can be parallel to target information (e.g., instructive feedback on Roman numerals when Arabic numerals are targeted), expansions on target information (e.g., instructive feedback on word definitions when sight words are targeted), or novel and unrelated to target information (e.g., instructive feedback on colors when shapes are targeted). Werts et al. (1995) suggested that when instructive feedback occurs within the context of systematically planned instruction, either in one-on-one or small group formats, student acquisition of additional non-target information is facilitated through incidental learning. Previous research has shown that instructive feedback can be used to increase the number of learning targets acquired (Doyle et al. 1990a; Werts et al. 1992), as well as the rapidity of learning for future targets after they were directly targeted in later instruction (Holcombe et al. 1993; Wolery et al. 1991). Thus, instructive feedback is an attractive procedure for increasing instructional efficiency because it increases learning while placing a minimal planning burden on teachers and no additional demands on learners.

In a previous review of 24 instructive feedback studies, researchers concluded that this procedure can increase learning efficiency for a variety of populations (Werts et al. 1995). In controlled studies of instructive feedback, typically developing learners as well as those diagnosed with autism, mild-to-moderate intellectual disabilities, developmental delays, behavior disorders, learning disabilities, emotional disorders, hearing impairments, and speech and language delays acquired additional non-target information (Werts et al. 1995). Participant ages spanned from 3 to 21 years. Studies included in the review featured all types of non-target information: parallel, expansion, and novel. Across participants, instructive feedback was provided in different modalities, including verbally, visually, or a combination of both verbal and visual presentations. Studies demonstrated the effective use of the procedure by both researchers and teachers, both in one-to-one and small group settings. The amount of additional learning targets acquired by learners ranged from 22.2 to 88.9% net gain of additional non-target information for individual performance. Participants who were exposed to non-target information delivered to peers (i.e., observed the instructive feedback procedure used with a peer in a small group format) acquired between 31.9 and 76.6% of the instructive feedback of their peers. A total of 811 non-target stimuli were taught to 113 students across studies and were assessed for maintenance for 28 students. Maintenance data were mixed with some students performing lower in maintenance conditions than in treatment conditions, but some performing the same or better when assessed for maintenance of acquired instructive feedback behaviors (Werts et al. 1995).

Despite the strong evidence base supporting the embedding of instructive feedback into response prompting procedures, this technique is still largely unknown and unused by practitioners. Thus, the purpose of the current paper was to review the studies of instructive feedback for students with disabilities that have been

published since 1995, in order to synthesize and report the findings of recently accumulated evidence, and advance recommendations regarding the use of this procedure. Our research questions were as follows: (a) For what populations is the instructive feedback procedure effective? (b) What settings and instructional arrangements facilitate instructive feedback? (c) What is the extent to which instructive feedback increases learning target acquisition? and (d) What recommendations can be drawn from existing research for practice?

Methods

Eligibility Criteria

Participants

Studies of instructive feedback were eligible for inclusion if they featured at least one participant with a disability, regardless of diagnosis. Studies were not excluded based on the age, gender, disability type, or cognitive profile of participants. Studies that also included typically developing participants (in addition to those with reported disabilities) were eligible for inclusion as well.

Intervention and Instructional Parameters

Only studies of the instructive feedback procedure were eligible for inclusion in the current study. We defined this procedure as any embedding of additional non-target information in the consequent event of a learning trial after correct responding. This definition is consistent with that used in previous reviews of this procedure (Werts et al. 1995). Studies that featured this procedure but that did not refer to it as instructive feedback were eligible for inclusion in the current review. Studies were included if they investigated skill acquisition when non-target information was presented in both the antecedent and consequent events; however, studies were excluded if non-target information was exclusively presented during antecedent events of teaching trials.

The nature of instructive feedback requires that an agent (e.g., peer, general or special education teacher, behavior therapist, paraprofessional, researcher, or computer device) implement the procedure, and studies that included any category of implementer were eligible for inclusion in the current synthesis. Instructive feedback studies were also included regardless of instructional setting; instruction could occur in any teaching or real-world environment. Eligible studies featured any arrangement of implementer to participant, including one-to-one, one implementer to a dyad of students, or one implementer to a group of three or more students. These broad inclusion criteria ensured that we could comprehensively describe the instructive feedback literature published since 1995.

Outcomes

Inclusion for synthesis was restricted to studies that systematically investigated the skill acquisition associated with the presentation of non-target stimuli in consequent events of learning trials. Studies were excluded if they did not directly measure the gain of instructive feedback behaviors. Acquisition of peer instructive feedback or peer original targets through group instruction was not a requirement for inclusion, though studies that examined this were eligible for review.

Study Design and Publication Type

Inclusion parameters required potentially eligible studies to use empirical single-subject research designs (Kennedy 2005). Non-empirical literature on instructive feedback (e.g., reviews, reports, textbooks) was not eligible for inclusion. Potential studies were only eligible for inclusion if they were published dissertations, theses, or articles from peer-reviewed journals. Studies were included if they were published between 1995 and 2017. Studies that were published in 1995 were excluded if they were reported in Werts et al. (1995) previous review of instructive feedback literature. Studies were also excluded if they were not published or accessible in English.

Search

Information Sources

An extensive search of 97 databases was electronically performed through EBSCOhost using a university library to identify relevant publications from peer-reviewed journals. Publications that were not available online were requested through the interlibrary loan system. ProQuest Dissertations and Theses Global were also searched to identify potentially eligible dissertations and theses. All final electronic searches were completed on June 30, 2017. A backward search of eligible studies was performed to further identify potential citations that were not located through the original electronic searches.

Search Criteria

We created our search criteria according to the framework that is outlined by the PICOS method, which encourages researchers to create search criteria by describing the *participants*, *intervention*, *comparison, outcome*, and *setting* that define the research question (Thompson et al. 2012). Since we were interested in reviewing all studies of instructive feedback (intervention) that included individuals with disabilities (participants), regardless of comparison, targeted outcome, or setting, we relied solely on participant and intervention categories to create our search criteria. A list was established containing keywords for describing features of instructive feedback intervention studies and individuals with disabilities. Final search terms were

combined with a wildcard symbol to locate variations of our search terms within potential citations. Search criteria within categories were joined with the Boolean operator OR, and search criteria across categories were joined with the Boolean operator AND. The final search terms used in our synthesis are reported below:

Line 1: "instructive feedback" OR "secondary target*" OR "non target*" OR nontarget* OR "incidental teaching" OR "incidental learning" OR "presentation variable*"

Line 2: autism OR autistic OR asperger* OR asd OR "special education" OR "special needs" OR disorder* OR disabilit* OR EDB OR EDBD OR "developmental* delay*"

Study Screening

All results from EBSCOhost were initially converted into Research Information Systems (RIS) format, and pertinent information was then exported to Zotero (Version 4.0.29.15) to organize the citations. Exact duplicate results were automatically removed during importation into Zotero. The remaining results were then screened at the title and abstract level for potential inclusion. An abstract was omitted if it summarized a study that was clearly ineligible. Any remaining studies that were potentially eligible for inclusion were downloaded for further review at the full-text level and examined according to eligibility criteria. Studies screened at the full-text level were excluded if they were clearly not studies of the instructive feedback procedure, were literature reviews, were not published in English, featured procedures in which non-target information was embedded solely into antecedent events, or if they did not include sufficient information to review study parameters. In the event that two studies reported on the same experiment (i.e., a dissertation and a published study), we included the study that reported more information about the nature of the experiment and participant outcomes.

Coding

The final set of included studies was coded for participant characteristics and procedural parameters. Procedural parameters that were tracked in this review included those related to the original targets of the instructional procedure, the instructive feedback stimuli, the instructional arrangement and setting, and participant outcomes.

Participant Characteristics

Participant characteristics included age, gender, diagnosis, and cognitive ability level. Participants were classified into age groups of young children (3–8 years), older children (9–14 years), adolescents (15–24 years), and adults (25 or older). Diagnostic categories included autism spectrum disorder, attention deficit hyperactive disorder, intellectual disability, learning disorder, emotional behavior disorder,

speech and language impairment, developmentally delayed, "at risk" of receiving a diagnosis, visually impaired, and typically developing. The cognitive functioning of participants was recorded if an IQ score derived from a cognitive assessment was reported.

Original Targets and Instructive Feedback Stimuli

Final studies were coded for the original behavior targeted by the instructional procedure (original target), as well as the instructive feedback stimuli provided in the consequent event of trials. We also synthesized findings for the learning of peer original targets during group arrangements, and learning of peer instructive feedback. For each study, instructive feedback stimuli were classified as parallel, expansion, or novel to the original target. Instructive feedback was deemed parallel if both responses to the original and secondary targets were identical, novel if stimuli were unrelated, or as expansion when the instructive feedback extended upon the concept of the original target. These categories were mutually exclusive. We also categorized instructive feedback stimuli by mode of presentation. Feedback that was presented with spoken words was categorized as vocal. Feedback that featured a visual stimulus (e.g., a picture) was categorized as visual. Feedback that included motor actions that were physically modeled was categorized as a model. These categories were not mutually exclusive, and some studies featured instructive feedback stimuli that were both visually and vocally presented.

Instructional Arrangement and Setting

Included studies were coded for the instructional arrangement (i.e., ratio of instructors to students), the instructional setting, and the type of instructor. The instructor who provided instructive feedback was coded as one of several permissible categories: peer, paraprofessional, special education teacher, general education teacher, computer program, or research personnel. Instructional settings were categorized as special education classrooms that were separate from typically developing peers, general education classrooms, separate rooms within a school setting, clinical settings, or natural environment arrangements within the community or the home.

Outcome Measures

In order to evaluate the effectiveness of the instructive feedback procedure, we examined student learning across original targets, instructive feedback targets, peer original targets (i.e., original targets that were presented to peers in group instruction), and peer IF targets (i.e., instructive feedback that was presented to peers in group instruction). Student learning (gain) of instructive feedback was defined as the difference in percentage of correct receptive or expressive identification of instructive feedback stimuli from baseline to the final intervention probe. For studies that included multiple original targets, gain was calculated for each target and then divided by the total number of targets to yield an average percentage of gain for original targets for that study. This was coded directly from studies that reported

exact percentages in both baseline and final probe conditions. When studies reported a single percentage to represent gain, this percentage was coded. When studies displayed responding graphically, and plotted multiple data points for baseline and intervention probes, we calculated baseline averages through visual identification of data points and subtracted these averages from values reflected for final probes. Maintenance and generalization data were recorded for instructive feedback learned for both individual and group learning in studies that examined these parameters. For studies that included multiple maintenance probes, the final probe was used for comparison. We made this decision because we reasoned that the final data point best reflected maintenance of gain, as it was furthest in time from the offset of intervention.

Results

Study Selection

Our search of the databases yielded 3159 search results through EBSCOhost and ProQuest Dissertations and Theses Global. A total of 1295 duplicates were removed before the remaining 1864 entries were downloaded for further review at the title and abstract level. After the removal of non-eligible entries, 81 potential eligible citations were downloaded and screened at the full-text level. An additional 25 studies did not meet inclusion criteria and 56 studies remained. Two additional studies were excluded because they reported on the same participants and outcomes as two previously included studies. Thus, a total of 48 journal articles and 6 dissertations were included in this review.

Participants

Participant characteristics are described in Table 1. A total of 226 participants were included across 54 studies, of which 6 were dissertations. Of the 217 individuals for which gender was reported, 66% ($n=146$) were male and 34% ($n=75$) were female. For the 217 participants for whom age was reported, the mean age was 10.5 years (SD=5.8 years), and 102 were young children, 59 were older children, 53 were adolescents, and 3 were adults.

Disabilities were mixed across studies, and 51 participants had more than one reported diagnosis. The most prevalent diagnosis was intellectual disability; this diagnosis or a qualifying cognitive or adaptive score (i.e., standard score below 75) was reported for 103 participants. Other reported diagnoses included autism spectrum disorder (ASD; 60 participants), speech and language impairment (22 participants), learning disability (17 participants), developmental delay (16 participants), down syndrome (12 participants), attention deficit hyperactivity disorder (ADHD; 5 participants), seizure disorder (4 participants), clinical diagnosis of "multiple disabilities" (4 participants), emotional and behavioral disorder (EBD; 2 participants),

Table 1 Participant demographics

References	*n*	Gender (f, m)	Age in years	Mean age (y.m)	Disability	Mean IQ	IQ measure
Anthony et al. (1996)	4	0, 4	10–11	10.9	EBD, LD, TD	86	WISC
Appelman et al. (2014)	4	0, 4	5–6	6.3	DD	NA	NA
Caldwell et al. (1996)	7	3, 4	8–12	10.5	ADHD, EBD, ID, LD	80.3	WISC
Campbell and Mechling (2009)	3	1, 2	5–6	6.2	LD	97	WISC
Carroll and Kodak (2015)	2	0, 2	4–5	5.3	ASD	NA	NA
Collins et al. (1995)	4	2, 2	16–18	16.9	ID	47.8	NA
Collins et al. (2017)	4	2, 2	16–19	17.5	ID	67	WJ
Colozzi et al. (2008)	4	1, 3	3–4	4.1	ASD, DS, ID	NA	NA
Colyer and Collins (1996)	4	1, 3	12–15	13.7	ID, SLI, SD	46.5	WISC
Cromer et al. (1998)	3	2, 1	11–13	12.5	ID	46.3	WISC
Delmolino et al. (2013)	5	3, 2	5–13	9.2	ASD	42.7	SB
Falkenstine et al. (2009)	3	1, 2	16	16.0	ID	47.8	WISC
Fetko et al. (2013)	3	1, 2	12–14	13.2	ADHD, ASD, DS, EBD, ID, TD	NA	NA
Fiscus et al. (2002)	4	3, 1	8–12	NA	NA	NA	NA
Griffen et al. (1998)	5	2, 3	6–11	NA	DS, ID	45-53	SB
Grow et al. (2017)	1	1, 0	7	7.0	ASD	NA	NA
Gursel et al. (2006)	5	3, 2	11–14	12.6	DS, ID	NA	NA
Haq et al. (2017)	2	1, 1	6–10	8.0	ASD, FX	NA	NA
Johnson et al. (1996)	5	1, 3	16–17	16.8	ID, LD	79.8	WISC
Jones and Collins (1997)	3	3, 0	31–45	36.0	ID	51	WISC
Lane et al. (2015)	6	1, 5	4–5	4.5	ID, SLI	NA	NA
Leaf et al. (2017)	9	1, 8	4–8	5.8	ASD	108.3	WISC, WPPSI
Ledford et al. (2008)	6	0, 6	5–8	6.8	ASD, SLI	NA	NA
Loughrey et al. (2014)	2	0, 2	4	4.0	ASD	NA	NA

Table 1 (continued)

References	*n*	Gender (f, m)	Age in years	Mean age (y.m)	Disability	Mean IQ	IQ measure
Nottingham et al. (2017)	2	1, 1	5–8	6.5	ASD	NA	NA
Olszewski et al. (2017)	6	1, 5	4–5	4.6	TD	NA	NA
Özkan and Gürsel (2011)	3	0, 3	15–17	16.0	ID	57	SB
Parker and Schuster (2002)	4	3, 1	15–19	17.0	ID, TD	NA	NA
Parrott et al. (2000)	5	3, 2	6–8	7.0	ASD, DS, ID, SLI	NA	NA
Pennington et al. (2014)	5	0, 5	7–10	8.0	ASD, ID	68	BDI, WISC
Riggs et al. (2013)	5	2, 3	14–18	15.8	ID	50.8	CTNI, KBIT, RIAS, WISC
Ross and Stevens (2003)	3	0, 3	9–10	10.3	ID, LD, OHI	71	WISC
Schuster et al. (1996)	3	1, 2	10–11	10.8	DS	48	SB, WISC
Shepley et al. (2016)	3	0, 3	4–6	5.5	ASD, DD	NA	NA
Singleton et al. (1995)	2	0, 2	7–11	9.4	DS, ID	41	NA
Stewart et al. (1997)	3	0, 3	5–6	5.9	AI	NA	NA
Taylor et al. (2002)	4	1, 3	16–20	17.7	ID	45.7	WISC
Tekin-Iftar (2003)	4	2, 2	10–13	13.1	DS, ID, TD	NA	NA
Tekin-Iftar et al. (2003)	3	1, 2	13–14	14.1	ADHD, AI	69	SB
Tekin-Iftar et al. (2008)	2	0, 2	7–8	7.5	ID	NA	NA
Tullis et al. (2017)	3	2, 1	6–7	6.6	ASD	NA	NA
Vladescu and Kodak (2013)	4	1, 3	3–7	5.2	ASD	NA	NA
Wall and Gast (1999)	12	6, 6	16–21	18.8	ID	43.1	SB, WAIS, WISC
Werts et al. (2003)	4	0, 4	11	11.4	LD, SLI	71	WISC
Werts et al. (2011)	4	1, 3	16–18	17.5	ASD, DS, DD, ID, SLI	65.5	WAIS, WISC
Werts et al. (1996)	3	1, 2	5–6	5.6	DD, TD	64.5	SB, WPPSI
Whalen et al. (1996)	3	1, 2	6–9	7.4	ID, TD	59.5	WISC
Wolery et al. (2000)	3	3, 0	15–19	17.02	ID	NA	NA

Table 1 (continued)

References	*n*	Gender (f, m)	Age in years	Mean age (y.m)	Disability	Mean IQ	IQ measure
Dissertations and Theses							
Alotaibi (2002)	6	3, 3	5–7	6.1	ASD, ID	44	BDI, BAY, CAT/CLAM
Apple (2005)	3	0, 3	3–5	4.3	ASD	NA	NA
Berrong (2011)	4	2, 2	8–11	9.2	ASD, ID	49.5	WISC
Reichow (2008)	5	2, 3	3–5	4.3	ALB, ASD, DD, SD, VI	NA	NA
Rohena-Diaz (1998)	4	2, 2	12–15	13.0	ID	53.7	WISC, SB
Ryan (1999)	4	0, 4	10–11	NA	NA	NA	NA

ADHD Attention Deficit Hyperactivity Disorder, *AI* Auditory Impairment, *ALB* Albinism, *ASD* Autism Spectrum Disorder, *BAY* Bayley Scales of Infant and Toddler Development, *BDI* Battelle Developmental Inventory, *CAT/CLAMS* The Clinical Adaptive Test/Clinical Linguistic and Auditory Milestone Scale, *CTNI* Comprehensive Test of Nonverbal Intelligence, *DD* Developmental Delay or Disability, *DS* Down syndrome, *EBD* Emotional Behavioral Disorders, *f* female, *FX* Fragile X syndrome, *KBIT* Kaufmann Brief Intelligence Test, *m* male, *n* number of participants, *y.m* years.months, *ID* Intellectual Disability, *LD* Learning Disability, *OHI* Other Health Impairment, *RIAS* Reynolds Intellectual Assessment, *SB* Stanford Binet Intelligence Scale—Fifth Edition, *SD* Seizure Disorder, *SLI* Speech and Language Impairments, *TD* Typical Development, *VI* Visual Impairment; *WAIS* Wechsler Adult Intelligence Scale, *WISC* Wechsler Intelligence Scale for Children, *WPPSI-IV* Wechsler Preschool and Primary Scale of Intelligence

and Fragile X (1 participant). An additional 10 participants that were typically developing were included in studies with participants with disabilities.

Cognitive ability was measured and reported in various ways across studies in our review, and IQ scores were available from 29 studies. Across 111 participants (including those that were typically developing) for whom standard IQ was reported, scores ranged from 30 to 130, with a mean of 61 (SD = 22). Young children included in studies of instructive feedback had a mean IQ score of 75 (SD = 31), older children had a mean IQ score of 60 (SD = 16), adolescents had a mean IQ of 53 (SD = 15), and adult participants had a mean IQ of 49 (SD = 3).

Procedural Parameters

Parameters of study procedures are described in Table 2.

Instructors

Multiple types of instructors implemented the instructive feedback procedure across studies. Researchers (primary authors and research personnel) implemented the procedure in 32 studies. In some cases, these investigators were also certified special education teachers, but were not the primary educators of the participants. Special education teachers were reported as the primary implementer of instructive feedback for 19 studies, paraprofessionals in 4 studies, behavior therapists in 2 studies, peers in 2 studies, and a computer in 1 study. One study described the implementer as "the instructor" with no other identifying information. Three studies did not provide sufficient detail needed to categorize the instructor.

Setting

In 28 of the included studies, special education classrooms served as the setting of instruction. Five of these were described as "resource classrooms" within the school, and four were described as substantially separate rooms (self-contained). General education classrooms served as the instructional setting for six studies. Nine studies reported hospital or university-based clinics as the setting of instruction. Functional settings within the community or school, such as the cafeteria, kitchen area, restroom, and first-aid room were reported as the setting for six of the studies, and two studies reported that at least one participant received instructive feedback intervention either in their daycare setting or in their home. In some studies, the setting of instruction varied across participants.

Grouping

Instruction was provided in several different groupings for the studies in our review. Direct teaching of original targets and systematic exposure to instructive feedback occurred in an implementer-to-participant ratio of 1:1 in 34 of the 54 included studies. An instructor to participant ratio of 1:2 was reported in 9 of the studies, 1:3 in

Table 2 Instructive feedback procedural parameters

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Anthony et al. (1996)	SED, GEN	RSCH	1:1, 1:3	Name state when given capital city	Identify state outlines and landmarks	E	VI, VO	16, 28, (44)	77.8		
Appelman et al. (2014)	SED	RSCH	1:2	Read English sight words	Spanish translations	E	VI, VO	12, 24, (48)	85.5	41.5	19
Caldwell et al. (1996)	SED	SPED	1:1	Name state outlines, read vocation words	State motto, vocation duties	E	VO	8/10, NA, (18)	34.6		
Campbell and Mechling (2009)	SED	RSCH	1:3	Name target letter sounds	Naming letters	E	VI, VO	6, 18, (18)	14.6	49.9	44.5
Carroll and Kodak (2015)	CLIN	T	1:1	Fill-in associations for functional categories	Novel responses to original target	E	VO	8, NA, (NA)	NA		
Collins et al. (1995)	SED	Peers	1:1	Read cooking words	Word definitions	E	VO	16, NA, (16)	59.3		
Collins et al. (2017)	COM	RSCH	1:1	Employment task of plant care	Photosynthesis information	E	VO	5, NA, (5)	54.2		
Colozzi et al. (2008)	SED	PARA	1:1, 1:4	Pretend play, read words	Fill-in responses related to play skill	E	VO	4, 16, (20)	59.6	49-92	69

Table 2 (continued)

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Colyer and Collins (1996)	SED	RSCH	1:1	Counting money with next dollar strategy	Dollar amount	E	VO	NA	11.5		
Cromer et al. (1998)	SED	SPED	1:3	Identify prescription bottle information	Identify related information to prescription bottles	E	VO	12, NA, (36)	76.8		
Delmolino et al. (2013)	SED	RSCH	1:1, 1:2	Label animals, school supplies, kitchen items	Identify the features and functions of original target	E	VO	3, 6, (18)	21.7, 16.7	33.3	33.3
Falkenstine et al. (2009)	SED	RSCH/SPED	1:3	Tell time, read arts and humanity words, identify geography terms	Tell time, set a watch, identify functions, look up words in dictionary, capitals of states, and spell state names	E	MOD, VO	30, 90, (90)	87.3	42.2	48.6

Table 2 (continued)

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Fetko et al. (2013)	SED	Peers	1:1	Chained leisure skill of playing card game	Science core facts	N	VI	4, NA, (4)	66.7		
Fiscus et al. (2002)	COM	RSCH/SPED	1:1	Chained task of food preparation skills	Identify words and sentences from recipes, or utensil function	N, E	VI, VO	51	31.2		
Griffen et al. (1998)	SED	SPED	1:1	Read community based words	Label and identify related information to community signs	N	VI, VO	8/16, NA, (64)	87.5 - 100		
Grow et al. (2017)	CLIN	RSCH	1:1	Label features of animals, objects, or food	Vocal and motor play behaviors	N	VO, MOD	3, NA, (3)	50		

Table 2 (continued)

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Gursel et al. (2006)	SED	RSCH	1:2	Identify provinces, rivers, and border countries of Turkey, and label associated information	Features and functions of original targets	E	VO	9, 18, (45)	39.9	66.2	
Haq et al. (2017)	ROOM	RSCH	1:1	Label common household objects, label reinforcers, and fill-in for functional skills	Label common objects, reinforcers, and fill-ins	N	VI, VO	NA	63.3		
Johnson et al. (1996)	ROOM	RSCH/SPED	1:5	Read science vocabulary words	Definitions of original targets	E	VO	20, NA (20)	5		
Jones and Collins (1997)	COM	RSCH	1:3	Food preparation skills using a microwave	Nutrition and safety facts	E	VO	6, NA, (6)	98.1		
Lane et al. (2015)	SED	RSCH	1:2	Identify sight words	Peer social information	N	VI, VO	6, NA, (36)	53.1	58.3	

Table 2 (continued)

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Leaf et al. (2017)	CLIN	RSCH	1:3	Identify pictures of comic book characters or athletes	Feature of original target	E	VO	2, 6, (18)	98.3	95.6	99
Ledford et al. (2008)	ROOM	RSCH	1:2	Expressive identification words and phrases related to community signs	Identify stimulus that represents target word	E	VI	6, 12, (36)	95.8	91.7	88.9
Loughrey et al. (2014)	CLIN	RSCH	1:1	Receptive identification food category name	Identify food category names	E	VI, VO	3, NA, (3)	98.3		
Nottingham et al. (2017)	CLIN, COM	RSCH	1:1	Expressive identification of pictures of objects, animals, and food	Identify objects, animals, and food	N	VI, VO	15, NA, (45)	66.7 - 100		
Olszewski et al. (2017)	ROOM	RSCH	1:3	Letter names and sound identification	Letter names and sounds	E	VI, VO	32, NA, (32)	28		

Table 2 (continued)

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Özkan and Gürsel (2011)	SED	RSCH	1:1	Read and comprehend warning labels	Definition of warning labels	E	VI, VO	16, NA, (16)	77		
Parker and Schuster (2002)	COM	SPED	1:4, 1:1	Read grocery and occupational words, define prefixes, identify elements	Feature and class of targets, job descriptions, words with target prefix	E	VO	9-15, 48, (48)	42.8	16	33
Parrott et al. (2000)	ROOM	RSCH	1:1	Task analysis for hand washing	Facts related to steps in original target	E	VO, MOD	9, NA, (9)	71.2		
Pennington et al. (2014)	SED	SPED, PARA	1:1	Construct story with sentences, answer questions related to story	Reading sight words of original target	E	VI, VO	NA	33.8		
Riggs et al. (2013)	SED	RSCH/SPED	1:1	Genetic information	Descriptions of diseases, propensity for inherited traits, solutions	E	VI, VO	20, NA, (20)	100		

Table 2 (continued)

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Ross and Stevens (2003)	SED	SPED	1:3	Written spelling of social studies words	Meaningful sentences using original target	E	VO	12, 36, (36)	77.7	72	29.3
Schuster et al. (1996)	SED	RSCH/SPED	1:3	Expressive identification of grocery words and peer reinforcers	Function of original target words	E	VO	12, 36, (36)	91.7	53.7	88
Shepley et al. (2016)	SED	RSCH/SPED	1:3	Read environmental text	Read sight words	N	VI, VO	6, 18, (18)	3.7	72.8	25
Singleton et al. (1995)	SED	RSCH/SPED	1:2	Expressive identification of community signs	Word/statement defining original target	E	VO	8, 16, (20)	71.4	50.8	41
Stewart et al. (1997)	CLIN	RSCH	1:1	Sight word articulation	Read sight words that were original targets	P	VI, VO	30, NA, (30)	42.7		
Taylor et al. (2002)	SED	SPED	1:1	Task analysis of laundry skills	Read associated sight words	E	VI, VO	8, NA, (8)	81,3		

Table 2 (continued)

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Tekin-Iftar (2003)	ROOM	SPED	1:1	Expressive identification of community signs	Identify meanings of original targets	E	VI, VO	12-15, NA, (25)	96.5		
Tekin-Iftar et al. (2003)	ROOM	RSCH/SPED	1:1	Expressively identify first-aid materials	Functions of stimuli	E	VO	9, NA, (13)	74.1		
Tekin-Iftar et al. (2008)	CLIN	SPED	1:1	Label tools	Functions of stimuli	E	VO	12, NA, (13)	49.5		
Tullis et al. (2017)	CLIN	RSCH	1:1	Receptively identify social dilemmas	Explanation for scenario in original target	E	VI, VO	9, NA (9)	74.8		
Vladescu and Kodak (2013)	CLIN	T	1:1	Label objects and fill-in statements	Label and fill = ins	E	VI, VO	3/6, NA, (24)	80		
Wall and Gast (1999)	COM	NA	1:2	Vocational skill of bagging groceries	State nutritional information associated with original targets	E	VO	10-20, NA, (20)	56.7		51.7

Table 2 (continued)

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Werts et al. (2003)	SED	RSCH	1:2	Label state outlines	Read words that described a feature of original target	E	VI, Vo	8, NA, (8)	92.5		
Werts et al. (2011)	SED	RSCH/SPED	1:5	Meaning of social studies words using fill-in statements	Civics or U.S. citizenship test information	N	VI, VO	18, 18, (19)	54.2		
Werts et al. (1996)	GEN	PARA	1:1, 1:3	Name coin or coin combination values	Read number words of original targets	P	VI, VO	8, 8, (8)	35-72		
Whalen et al. (1996)	GEN	SPED	1:3	Addition facts up to the sum of 10	Read sight words	N	VI, VO	9, 27, (27)	94.4	81.4	80
Wolery et al. (2000)	SED	RSCH	1:1	Read sight words	Read unrelated sight words	E	VI	5, NA, (15)	60		
Dissertations and Theses											
Alotaibi (2002)	SED	RSCH	1:1	Read functional sight words/ phrases	Sight word definition	E	VO	12, NA, (31)	62%		

Table 2 (continued)

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Apple (2005)	SED	RSCH	1:1	Receptive discrimination based on feature, function, and class	Discriminate between features, function and class	N	VO	6, NA, (12)	24.8		
Berrong (2011)	SED	CAI, SPED	1:1	Receptive identification of general education science content for states of matter, life cycle, food chain	Related stimuli to original target	E	VI, VO	9, NA, (9)	71.9		
Reichow (2008)	SED	SPED	1:1	Name numbers, colors, equations, and common objects	Identify numbers, colors, equations, common objects	N	Vi, VO	4, NA, (20)	100		
Rohena-Diaz (1998)	SED	RSCH	1:1	Read store sight words from community	Associated words from original target	E	VO	20, NA, (20)	74		

Table 2 (continued)

Reference	Setting	Instructor	Grouping	Target behavior	IF target	Type	Mode	# of stimuli[a]	% net gain IF	% net Gain Obs[b]	% net gain Inc[c]
Ryan (1999)	ROOM	NA	1:2	Multiplication facts	Reciprocal multiplication fact of original target	P	VI, VO	5, 5, (10)	54		

CAI computer aided instruction, *CLIN* clinic, *COM* Community, *E* Expansion, *GEN* general education setting, *IF* instructive feedback, *MOD* model, *N* novel, *NA* not available, *P* parallel, *PARA* paraprofessional, *ROOM* separate room in clinic or school, *RSCH* Researcher, *SED* Special education setting, *SPED* special education teacher, *T* therapist, *VI* Visual presentation, *VO* Vocal presentation

[a]#, #, (#) refers to the number of targets that each individual was assigned, the number of targets available through group exposure, and the total number of different targets for the study

[b]Obs refers to observational learning, the term we used to describe participant acquisition of peers original targets

[c]Inc refers to incidental learning, the term we used to describe participant acquisition of peers instructive feedback targets

12 studies, 1:4 in 2 studies, and 1:5 in 2 studies. Group instructional arrangements allowed participants to observe both the original targets and instructive feedback of their peers. Of the studies that featured group instructional arrangements, 15 studies reported on the acquisition of peer's original targets and 14 studies reported on participant acquisition of peer's instructive feedback.

Original Targets

Various learning objectives were targeted across the 54 instructive feedback citations that were coded and reviewed. Adaptive daily living skills, such as learning how to use a microwave to prepare food (Jones and Collins 1997), hand washing (Parrott et al. 2000), and cleaning laundry (Taylor et al. 2002), served as original targets in seven studies. Academic skills were targeted in 44 studies. Examples of academic information targeted in instructive feedback studies include science and environmental vocabulary (Berrong 2011), time concepts (Falkenstine et al. 2009), money counting (Colyer and Collins 1996), and multiplication facts (Ryan 1999). Finally, three studies reported that social skills served as original targets. Examples of social skills targeted include playing a card game (Fetko et al. 2013) and social information related to peers (Lane et al. 2015).

Instructive Feedback Stimuli

Instructive feedback stimuli also spanned various functional and academic categories and were often derived from upcoming IEP objectives that the teacher planned to target in the future. Functional instructive feedback stimuli were presented in five studies. These instructive feedback stimuli were related to daily living tasks such as definitions of prescription bottles (Cromer et al. 1998), meanings of warning labels (Özkan and Gürsel 2011), and nutrition and safety facts for common items (Jones and Collins 1997). Academic instructive feedback was featured in 49 studies. These instructive feedback stimuli included letters (Campbell and Mechling 2009), numbers (Reichow 2008), sight words (Shepley et al. 2016), definitions of targeted vocabulary (Collins et al. 1995), state outlines and associated landmarks of targeted states (Anthony et al. 1996), science facts about photosynthesis (Collins et al. 2017), time concepts (Falkenstine et al. 2009), and money (Colyer and Collins 1996). Social skills such as play behaviors (Grow et al. 2017) were embedded as instructive feedback in three studies.

Instructive feedback stimuli were classified as expansion of the original target in 39 studies, parallel to the original target in for 3 studies, or novel to original targets in 12 studies. Additionally, chained behaviors served as original targets in two studies. In these studies, instructive feedback was presented after praise statements following each step of the task analyses.

Across the studies for which it could be determined, each individual participant was assigned between 3 and 20 instructive feedback stimuli ($M = 10$, SD = 6). The same instructive feedback stimuli and original targets were taught to each participant in 16 studies, and different instructive feedback and original targets were taught to each participant in 30 studies. The similarity of targets was unclear

in eight studies. In total, 1152 different instructive feedback stimuli were embedded across 50 studies. This count does not include four studies for which the number of instructive feedback stimuli was indeterminable (Carroll and Kodak 2015; Colyer and Collins 1996; Pennington et al. 2014; Haq et al. 2017). The number of exposures per trial that participants received for instructive feedback ranged from 1 to 6. In most cases, participants were only exposed to instructive feedback once per trial, but a few studies embedded instructive feedback in chained tasks, where each step provided an opportunity for instructive feedback presentation.

Instructive Feedback Gain

Across studies, participant gain of instructive feedback ranged from 0 to 100% ($M = 64\%$, $SD = 26\%$). Participants met mastery criteria for original targets in 47 of 54 studies, and gain in original targets ranged from 39 to 100% ($M = 90\%$, $SD = 15\%$). Across 15 studies for which it was measured, acquisition of peer instructive feedback information ranged from 19 to 99% ($M = 55\%$, $SD = 26\%$). Acquisition of peers' original targets ranged from 16 to 95% ($M = 59\%$, $SD = 23\%$) across 14 studies in which it was reported.

Generalization and Maintenance

The maintenance of instructive feedback gain was reported in 13 studies in this review. Maintenance ranged from 45 to 100% ($M = 88\%$, $SD = 15\%$). Nine studies examined generalization of instructive feedback acquisition across settings or instructors. Across these studies, generalization of instructive feedback ranged from 38 to 86% ($M = 66\%$, $SD = 17\%$).

Discussion

Primary Conclusions

This review summarizes the findings of the additional 54 studies of instructive feedback that were published since the previous review conducted by Werts et al. (1995). All studies demonstrated either (a) acquisition of additional non-target information directed toward participants or their peers, (b) increased rapidity of learning of target information after embedding, or (c) both. All studies also showed evidence that participants exhibited substantial gains in original targets, which suggests that learning is not interrupted by the addition of non-target information into teaching trials, at least when this information is embedded into consequent events. Thus, a rich literature exists to suggest that teachers can employ the instructive feedback procedure to increase the efficiency of the trial-based teaching.

Benefits of the Instructive Feedback Procedure

Flexibility Across Learners and Instructors

Instructive feedback can be used effectively with a wide array of learners, across age groups and disability categories. Studies included participants as young as 3 and as old as age 45. Both typically developing participants and those with disabilities were also represented in the participant group. Multiple diagnostic categories were represented, and participants across diagnostic categories exhibited some amount of gain on instructive feedback targets. The instructive feedback procedure is also useful because it can be easily employed by a wide range of implementers. Any classroom professional, whether a general or special education teacher or a paraprofessional, can systematically plan to present additional non-target information to students. Even typically developing peers can serve as implementers, or as learning partners in group arrangements of instructive feedback: Collins et al. (1995) and Fetko et al. (2013) trained up to 26 different peers to implement trial-based instruction and to embed extra information into learning trials. Both research groups found that participants met mastery criteria for original targets and exhibited pre-to-post gain of instructive feedback stimuli. The fact that peers can be integrated either as implementers or as learning partners in the instructive feedback procedure has implications for the use of this procedure in inclusive settings. Enriched interactions between children with disabilities and their typically developing peers is a notable goal of inclusion, and the instructive feedback procedure could be used to facilitate these interactions in structured learning situations.

Flexibility Across Instructional Arrangements

Group instructional arrangements of the instructive feedback procedure also provide increased embedding opportunities for non-target information, as children in group arrangements are exposed to the original and embedded targets presented to their peers. Parker and Schuster (2002) were interested in the ability of participants to acquire individual instructive feedback stimuli, along with the original targets and instructive feedback of peers through group exposure. Students learned between 25 and 83% of their own instructive feedback and showed a gain of up to 59% of the instructive feedback of their peers. Similarly, Leaf et al. (2017) taught nine children to label pictures of preferred stimuli such as comic book characters and basketball players. Associated information was included as instructive feedback, and students learned their own original targets (100%) and instructive feedback (98%), as well as the original targets (95%) and instructive feedback (99%) of their peers.

Flexibility Across Learning Objective Categories

The instructive feedback procedure can be flexibly used to target different types of learning objectives, even those that are unrelated to the original targets of instruction. For example, Whalen et al. (1996) taught participants addition math facts and embedded sight words as instructive feedback. In other studies, functional skills

served as the original targets of instruction and academic learning objectives were embedded. Fiscus et al. (2002) targeted cooking with direct teaching and provided related food words and sentences as the instructive feedback, with an overall gain of 53% in instructive feedback behaviors. Similarly, Collins et al. (2017) taught students a vocational task of caring for plants and embedded six photosynthesis facts as instructive feedback, with 52% gain in instructive feedback. Finally, some investigators used the instructive feedback procedure to target social objectives. Grow et al. (2017) taught participants to comment on the features of objects, animals, or food and embedded instructive feedback on play skills, with reports of 50% gain in instructive feedback. Lane et al. (2015) directly taught preschool students to expressively identify functional sight words and embedded (a) examples of sharing behavior (i.e., by teaching peers to share reward tokens with the group) and (b) social information about peer preferences in group instructional arrangements (i.e., by asking peers questions such as "What is your favorite snack?"). The embedding of social information that is unrelated to original targets broadens the learning opportunities for students. It may facilitate acquisition of social behaviors by allowing students to observe social interaction norms in a more structured format, in which certain cues might be more salient and thus easier to acquire.

Efficient Instruction

Many studies demonstrated that instructive feedback implementation can preserve the instruction time that teachers have available to students. Reichow (2008) provided strong evidence for the efficiency of the instructive feedback procedure by comparing the overall instructional time for original target acquisition with and without instructive feedback. Instructional time was 36.2 min per target without instructive feedback, and only 18.4 min per target in trials that included extra targets as instructive feedback. Participants also learned twice as many behaviors during teaching that utilized the instructive feedback method with 100% acquisition across instructive feedback for four out of five participants. Seven studies also examined whether participant acquisition was faster for targets that had previously been embedded as instructive feedback stimuli. Reports of the effectiveness of the instructive feedback procedure on the subsequent efficiency of acquisition were generally positive. Delmolino et al. (2013) reported increased efficiency of acquisition for two participants and no differences for the remaining two after directly teaching stimuli that previously served as instructive feedback. Wolery et al. (2000) reported that previously embedded targets were learned in less trials and with less errors compared to the acquisition of targets with no prior exposures as instructive feedback. Tullis et al. (2017) and Vladescu and Kodak (2013) also reported that participants acquired previously embedded skills in less trials compared to original targets that were not previously embedded.

Flexible Implementation

Those who choose to implement the procedure can vary the presentations of instructive feedback and individualize the procedure to student need. Werts et al. (2011)

explored whether instructive feedback could be variably attached to any original target, deviating from former studies that paired instructive feedback with a given target. Although instructive feedback stimuli followed different original targets throughout their study, mean participant instructive feedback gain was 54.2%. Nottingham et al. (2017) examined whether the number of instructive feedback stimuli embedded in a single trial affected participant acquisition of instructive feedback. When only one instructive feedback stimulus was embedded in each trial, participants acquired 100% of their original targets, as well as 66% of the instructive feedback. When two instructive feedback stimuli were embedded in each trial, participants acquired 100% of original targets and instructive feedback. Finally, Cromer et al. (1998) demonstrated that participants acquired instructive feedback that was embedded into either continuous or intermittent schedules of reinforcement, suggesting that intermittent exposure to instructive feedback can still facilitate acquisition of embedded stimuli.

Limitations of the Instructive Feedback Procedure

Although our review strongly supports the use of the instructive feedback procedure to increase the efficiency of trial-based teaching, few researchers were able to demonstrate experimental control of the procedure on instructive feedback targets. While experimental control was demonstrated for original targets across most studies, demonstration of experimental control on instructive feedback targets would require more frequent probes of non-target information. More frequent probes can be burdensome to a learner, particularly when correct responding is highly unlikely. In addition, daily probes can lead to undetected response generalization when instructive feedback targets are closely related to original targets. Some researchers used innovative design approaches to demonstrate experimental control of the instructive feedback procedure on acquisition of non-target information. After using the instructive feedback procedure to embed non-target information in learning trials, Reichow (2008) directly targeted previous instructive feedback targets with explicit instruction, and demonstrated that targets that were previously embedded as instructive feedback were acquired faster than original targets that were never embedded. Nottingham et al. (2017) probed control targets, which were not directly targeted or embedded with the instructive feedback procedure, in order to demonstrate that acquisition of instructive feedback targets was likely the result of embedded exposure.

Strengths of the Review

This synthesis of recent instructive feedback studies has several strengths. Though the instructive feedback procedure has been studied exhaustively, this is the first systematic review to summarize the studies of this procedure that have been conducted in the last two decades. Our search strategy included gray literature and a large number of electronic databases, ensuring that our synthesis was comprehensive. The

high number of studies identified in this review provides a robust literature from which we confidently draw conclusions.

Limitations of the Review

This review has some limitations that should be noted. While we attempted to use a comprehensive search strategy to identify all relevant studies of the instructive feedback procedure, it is possible that studies that featured the procedure but used different terminology were not captured in our search. Our goal was to maximize the possibility of including studies that may have described instructive feedback using different terminology, and we expanded our search terms to accommodate this possibility. Inclusion criteria also limited citations to those that were published in English, and although Yalçin and Akmanoğlu (2013) provided an abstract in English that indicated 100% gain of instructive feedback, this study was not eligible for inclusion since the full-text was not published in English. It is possible that other studies published in other languages further support the use of the instructive feedback procedure. We also extracted numerical data from single-subject graphs through visual analysis. This method is not immune to human error, and is thus a limitation of our review. Finally, while most systematic reviews include an evaluation of the quality of the literature, we declined to evaluate the quality of the single-subject studies included in this review according to parameters outlined by either Reichow et al. (2008) or Horner et al. (2005). While many of the included studies established experimental control in regards to the effect of the intervention on targeted outcomes, they failed to do so for the outcome of interest in this review: acquisition of instructive feedback stimuli. Thus, we reasoned that an evaluation of the quality of the literature might inadequately reflect the quality of evidence as it pertains to the effect of the instructive feedback procedure on the acquisition of embedded instructive feedback stimuli. Readers should give this limitation consideration when interpreting the conclusions of this review.

Future Directions

In the future, researchers examining the instructive feedback procedure should attempt to demonstrate experimental control over the instructive feedback targets. An adapted alternating treatments design (Sindelar et al. 1985) could be used to compare the rate of acquisition of targets that were previously embedded with the instructive feedback procedure with those that were not. Alternatively, instructive feedback targets could be infrequently probed throughout intervention on original targets in multiple baseline or multiple probe designs, rather than simply before and after intervention.

Researchers might also examine whether the embedding of non-target information in the antecedent condition is a comparably effective way to improve the efficiency of trial-based teaching procedures. Although our inclusion criteria excluded seven studies in which non-target information was embedded solely in the antecedent condition of learning trials, four studies that investigated both antecedent and

consequent placement of non-target information were included in our review (Haq et al. 2017; Nottingham et al. 2017; Vladescu and Kodak 2013; Wolery et al. 2000). In all four studies, participants acquired some non-target information regardless of antecedent or consequent event placement. The addition of antecedent embedding could expand the amount of information that could potentially be embedded in a learning trial, or it could provide a second opportunity to expose the learner to information embedded in consequent events of learning trials.

Future researchers should also examine the extent to which the instructive feedback procedure could be expanded beyond a rigid trial-based format in order to facilitate generalization of acquired responses. To what extent can this procedure be effectively embedded into naturalistic contexts or implemented by parents and caregivers? Some might say that naturalistic language interventions already pair instructive feedback with positive consequences. For example, a speech therapist might reinforce a child's play action and spoken phrase, by repeating the phrase, but using correct grammar (recasting). In this case, we might think of the imitation and joining in play as the positive consequence used to reinforce speaking and play behaviors, and the correct grammar as the instructive feedback. Caregivers could also be taught to embed instructive feedback into praise statements (e.g., "Thank you for putting on your shoes. This is how we tie our shoes."). Alternatively, investigators could use group design to examine the effectiveness of embedding instructive feedback in behavior-specific praise in large group classroom settings. Behavior-specific praise is an evidence-based practice that teachers are already taught to employ in classroom instruction (Brophy 1981; Sutherland et al. 2001). Combining instructive feedback with behavior-specific praise might allow teachers to facilitate learning of future academic targets that while increasing positive student behaviors.

Conclusion

Instructive feedback is an effective procedure for increasing the efficiency of learning, with a large body of literature that spans three decades supporting its effectiveness. However, instructive feedback is still relatively unknown to practitioners. This review suggests that the instructive feedback procedure has accrued a broad evidence base that supports its addition into textbooks that are widely used for special educators and behavior analysts (e.g., future editions of *Applied Behavior Analysis*).

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